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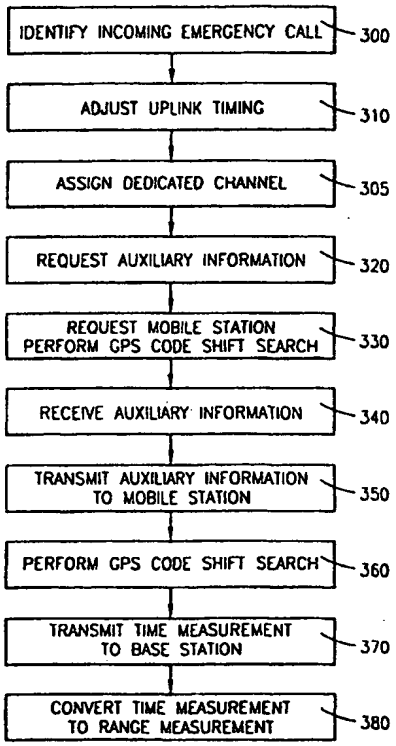
(54) Title: METHOD AND APPARATUS TO COMMUNICATE AUXILIARY AND LOCATION INFORMATION BETWEEN CELLULAR TELEPHONE NETWORK AND GLOBAL POSITIONING SYSTEM

(57) Abstract

A method and apparatus for communicating auxiliary information between a cellular telephone network and a GPS receiver positioned within a mobile station and identifying the location of the mobile station. A dedicated channel between the mobile station and the network is assigned by the network and uplink timing between the mobile station and the network is adjusted. The network requests auxiliary information and also requests the GPS receiver to perform a GPS code shift search at a common reference time. Upon receiving the auxiliary information, the network transmits the auxiliary information to the GPS receiver which then performs the GPS code shift search. The GPS receiver incorporates a bank of correlators and accumulators to perform multiple parallel searches for various Doppler frequency shifts resulting from a moving GPS receiver. The mobile station subsequently transmits the location information to the cellular telephone network.



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METHOD & APPARATUS TO COMMUNICATE AUXILIARY & LOCATION INFORMATION BETWEEN CELLULAR TELEPHONE NETWORK & GLOBAL POSITIONING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is related to commonly assigned U.S. Patent Application Serial number 08/950,690, entitled "Reduced Global Positioning System Receiver Code Shift Search Space for A Cellular Telephone System," filed October 15, 1997 (Docket No. 27951-00170; inventors William Camp, Kambiz Zangi and Rajaram Ramesh), the disclosure of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention pertains in general to a method and apparatus for reducing code shift search time in a Global Positioning System receiver, and more particularly, to reducing code shift search time in a Global Positioning System receiver positioned within a cellular mobile station operating within a cellular telephone network.

Description of Related Art

It is desirable, and likely to be mandatory in the future, that cellular telephone networks be equipped to determine the geographical location of cellular telephones operating within the cellular telephone network. To meet this requirement it has been proposed that cellular telephones be equipped with Global Positioning System (GPS) receivers for determining the location of the cellular telephone. GPS receivers, however, are expensive, increase cellular telephone size, and consume the limited amounts of battery power available to the cellular telephone.

GPS receivers require auxiliary information also known as side information which refers to information such as the number of satellites in view, the Gold code number used by these satellites, the Doppler frequency for the signals transmitted by

these satellites, the time delays from these satellites to users located at the center of the cell, and the size of the search window for the Gold code used by each satellite in view.

A typical GPS receiver includes at least a signal acquisition circuit and a demodulation and decoding circuit. Most of the complexity resides in the acquisition circuit. The acquisition circuit tries to search through all Gold codes used by the GPS system with frequency and timing uncertainty. The goal is to identify the code, symbol boundary and Doppler frequency used by the GPS satellites in view. This is a very complicated and power consuming process because it involves three-dimensional search (code-time-frequency). Once the receiver acquires the GPS signals, reading ephemeris data is very straightforward. When auxiliary information is provided to a GPS receiver, the complexity of such a three-dimensional searching process can be significantly reduced.

To calculate the auxiliary information for the GPS receiver, however, the approximate location of the GPS receiver must be known. Moreover, the closer the actual location of the GPS receiver to the location used in calculating the auxiliary information, the smaller the resulting location search to be performed by the GPS receiver. A smaller search greatly simplifies the time measurement process. The search can be reduced to finding the relative code shift position locations to much less than a one millisecond code cycle. Furthermore, once a code shift position is located for a first GPS satellite, the GPS receiver recalibrates its timing and corrects errors in the predicted code shift positions for the remaining GPS satellites. For a more detailed explanation regarding the use of auxiliary information by GPS receivers, reference is made to the previously identified cross referenced application.

Code shift search time also varies with the speed at which the GPS satellite is moving. As the GPS satellite moves, a Doppler frequency shift occurs whose magnitude is dependent on the speed at which the GPS satellite is moving.

It would be advantageous, therefore, to devise a method and apparatus to communicate the auxiliary information from a base station of a cellular telephone network to a GPS receiver located within a mobile station and further to provide the GPS receiver with satellite elevation information such that the GPS receiver can

search the code shift position for a satellite having the highest elevation angle thereby reducing the time required for a GPS receiver to determine its location. It would still further be advantageous if the code shift search accommodated for a moving GPS receiver.

SUMMARY OF THE INVENTION

The present invention comprises a method and apparatus for communicating auxiliary information between a cellular telephone network and a GPS receiver positioned within a mobile station. A dedicated channel between the mobile station and the network is assigned by the network and uplink timing between the mobile station and the network is adjusted. The network requests auxiliary information, which among other information, includes satellite elevation angle information and upon receiving the auxiliary information, the network transmits the auxiliary information to the GPS receiver to perform a GPS code shift search at a common reference time and the GPS receiver then performs the GPS code shift search using the auxiliary information. The GPS receiver incorporates a bank of multiple correlators and accumulators which perform two dimensional searches of different time shifts and accumulators. The mobile station subsequently transmits time of arrival information to the cellular telephone network.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the method and apparatus of the present invention may be acquired by reference to the following Detailed Description when taken in conjunction with the accompanying Drawings wherein:

Figure 1 is a pictorial diagram of elevation angles for a plurality of Global Positioning System satellites with respect to a Global Positioning System receiver;

Figure 2 is a block diagram of auxiliary information transmitted from a base station to a mobile station;

Figure 3 is a flow diagram of a method to perform a call setup consistent with the present invention;

Figure 4 is a functional block diagram for plurality of correlators and accumulators for reducing the code shift search time of a global positioning receiver; and

Figure 5 is a flow diagram of a method for reducing the code shift search time of a global positioning receiver consistent with the block diagram of Fig. 4.

DETAILED DESCRIPTION OF EMBODIMENTS

Referring now to Fig. 1, there is illustrated a pictorial diagram of elevation angles for a plurality of Global Positioning System satellites with respect to a Global Positioning System receiver. A plurality of Global Positioning System (GPS) satellites 100A-N, in view of a GPS receiver 110 within a mobile station 111, have elevation angles A-N. Typically there are between five to eight GPS satellites 100A-N in view of the GPS receiver 110 at any given time.

Referring additionally now to Fig. 2, there is illustrated a block diagram of auxiliary information provided to a Global Positioning System receiver. Auxiliary information 140 contains a list 150 of the plurality of GPS satellites 100A-N in view of the GPS receiver, Doppler corrections 170 for each of the plurality of GPS satellites 100A-N, nominal code shift positions 180 which refer to code shift positions expected for users at a reference position within a cell (e.g. the center of a cell), degree of code shift search uncertainty 185 for each of the plurality of GPS satellites 100A-N based upon a universal coordinated time and a list of elevation angles 190 for each of the listed GPS satellites 150. Alternatively, the list of elevation angles 190 is eliminated and the satellites 100A-N are ordered within the list 150 according to the elevation angle A-N such that the GPS receiver 110 can identify the satellite having the greatest elevation angle A-N.

Referring now to Fig. 3, there is illustrated a flow diagram of a method to perform a call setup consistent with the present invention. Upon identifying a request from a mobile station as an emergency call (step 300), a cellular telephone network adjusts the uplink timing with a time advance command such that subsequent bursts sent by the mobile station are synchronous at the receive antenna interface of a serving base station (step 310) and assigns a dedicated channel between the mobile station and

the cellular telephone network (step 305). For example, in a Global System for Mobile communication (GSM) system, the mobile station requests a channel on the Random Access CHannel (RACH) and the cellular telephone network sends an Access Grant CHannel (AGCH) burst to assign the dedicated channel. To determine the time base at the mobile station, the cellular telephone network estimates the round trip propagation delay between the mobile station and the serving base station by measuring the timing of the RACH burst sent by the mobile station. The serving base station requests auxiliary information (step 320) and sends a request to a GPS receiver within the mobile station to perform a GPS code shift search at a common reference time (step 330). The common reference time is specified as an uplink absolute frame number (AFN). The serving base station receives the auxiliary information (step 340) and transmits the auxiliary information to the GPS receiver within the mobile station (step 350). The auxiliary information is transmitted to the mobile station via a Stand alone Dedicated Control CHannel (SDCCH) in a GSM cellular telephone network, via a Digital Control CHannel (DCCH) in an Digital Advanced Mobile Phone Service (DAMPS) system or via a Short Message Service (SMS) message.

The GPS receiver within the mobile station performs the GPS code shift search at the specified uplink absolute frame number (step 360) using the auxiliary information. The GPS receiver uses the satellite elevation information to search the satellite with the highest elevation angle first. Correlations between the received GPS signal and the Gold code generated by the GPS receiver with various code phases are calculated. It is understood that a GPS signal is a spread spectrum signal using direct sequence modulation in which each symbol is spread by a Gold code. Due to the Doppler effect, the chip duration of the received GPS signal is different from that of the Gold code generated by the GPS receiver. As a result, the GPS receiver may experience chip slips. Since the Doppler frequency of the received GPS signal is provided to the GPS receiver in the auxiliary information, however, the GPS receiver adjusts the chip slips when necessary thus achieving accurate code shift search. The code chip boundary at the uplink absolute frame number is used as a base line reference for a chip boundary used in adjusting chip slips. Once the GPS receiver

within the mobile station finishes the code shift search for each GPS satellite listed in the auxiliary information, it transmits the time measurement to the base station (step 370) and the cellular telephone network converts the time measurement into a range measurement (step 380).

Referring additionally now to Fig. 4, there is illustrated a functional block diagram for plurality of correlators and accumulators for reducing the code shift search time of a global positioning receiver. To perform a code shift search, the GPS receiver 110 uses the auxiliary information 140 to generate a Doppler frequency f(A-N) and a nominal code delay t(A-N) for each of the GPS satellites 100A-N. A Gold code generator 400 uses the auxiliary information 140 to generate a Gold code for each of the GPS satellites 100A-N. The GPS receiver 110 passes the Gold code into a series of delay lines 410 to produce Gold codes of different delays.

A plurality of correlators 420 calculate a correlation between the received GPS signal and the various Gold codes of different delays. The plurality of correlators 420 produce a plurality of correlation values C_L^m where m denotes that the correlation is performed over the m-th one millisecond interval which is the period of the Gold code and L denotes the number of delays added. To get a reliable code shift search in low signal to noise conditions, however, correlation over a longer period of time much greater than one millisecond may be necessary. Various problems develop when calculating correlations over a long period of time. First, coherency loss results from the fact that the nominal Doppler frequencies f(A-N), which are the frequencies expected by users located at a reference location in a cell (e.g. the center of a cell), obtained from the cellular telephone network may vary from the actual Doppler frequency by up to ten hertz. The difference in frequency causes a carrier phase change up to ten cycles per second. A second problem involves coherence timing which is a function of how fast the GPS receiver 110 is moving. For example, a GPS receiver 110 moving at sixty miles per hour has a coherency time which is one twentieth of the coherency time of a GPS receiver 110 moving at three miles per hour. Lastly, code chip slip due to the difference between the frequency references at the GPS satellites 100A-N and the GPS receiver 110 is more pronounced when correlation is performed over a long period of time.

To address these problems and reduce the code shift search time, the plurality of correlation values C_L^m during the n-th one millisecond interval, are combined into a vector $C^m = (C_1^m, C_2^m, \cdots C_{L_i}^m)$ by vector generator 430 and provided together with the nominal Doppler frequencies f(A-N) and nominal code delays t(A-N) to a plurality of accumulators 440 which combine the one millisecond correlation vectors $\vec{C}_l^m$ in different combinations. For example, the first accumulator performs coherent combining over two milliseconds, thus, the l-th element of the vector after accumulation is given by the expression:

$$A_l^1 = \sum_m \left| \sum_{n=0}^{1} C_l^{2m+n} \right|^2, \quad l=1,2,\ldots,L. \qquad \text{Expression (1)}$$

where the inner summation is coherent combining and the outer summation is non-coherent combining. Similarly, the last accumulator P performs coherent combining according to the expression:

$$A_l^P = \sum_m \left| \sum_{n=0}^{P-1} C_l^{Pm+n} \right|^2, \quad l=1,2,\ldots,L. \qquad \text{Expression (2)}$$

By performing coherent combining in a variety of combinations, each accumulator 440 is designed to be optimized to a GPS receiver 110 moving at a different speed. Thus, the first accumulator performs best for a fast moving GPS receiver 110 while accumulator P performs best for a stationary GPS receiver 110.

Finally, the largest accumulation value along with accumulation values from the two neighboring values of the same vector are passed through a quadratic interpolation 450 where a quadratic interpolation algorithm is used to produce a peak value. The peak value corresponds to the location information which is sent back to the cellular telephone network for location determination.

Referring additionally now to Fig. 5, there is illustrated a flow diagram of a method for reducing the code shift search time of a global positioning receiver consistent with the block diagram of Fig. 4. Utilizing the delay lines 410, Gold codes of various delays are produced (step 510). The plurality of correlators 420 calculate

correlation values from the Gold codes and a received GPS signal (step 520). The parallel to vector generator 430 serializes the calculated correlation values (step 530) and the plurality of accumulators 440 perform coherent combining of the serialized correlation values (step 540) to produce respective accumulator values (step 550). The quadratic interpolator 450 performs a quadratic interpolation on an output of the accumulator having a strongest accumulator value and the output of two neighboring correlators 420 (step 560).

Although embodiments of the method and apparatus of the present invention have been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

WHAT IS CLAIMED IS:

1. A method for communication auxiliary information and location information between a cellular telephone network and a GPS receiver positioned within a mobile station comprising the steps of:

assigning a dedicated channel between the mobile station and the cellular telephone network;

adjusting uplink timing between the mobile station and the cellular telephone network;

requesting auxiliary information;

requesting the GPS receiver to perform a GPS code shift search at a common reference time;

transmitting the auxiliary information to the GPS receiver within the mobile station;

performing the GPS code shift search; and

transmitting the location information to the cellular telephone network.

2. The method recited in claim 1, wherein the transmitted location information is a physical location of the GPS receiver.

3. The method recited in claim 1, wherein the transmitted location information is time-measurement information which indicates the location of the GPS receiver.

4. The method recited in claim 1, further including the step of identifying an incoming call to the cellular telephone network as an emergency call.

5. The method recited in claim 1, wherein the step of assigning a dedicated channel further comprises the step of sending a signal burst in response to a request from the mobile station on another channel.

6. The method recited in claim 1, wherein the step of assigning a dedicated channel further comprises the step of sending an Access Grant CHannel burst in response to a request from the mobile station on a Random Access CHannel.

7. The method recited in claim 1, wherein the step of requesting the GPS receiver to perform a GPS code shift search at a common reference time comprises the step of requesting the GPS receiver to perform the GPS code shift search at a common reference time.

8. The method recited in claim 1, wherein the step of transmitting the auxiliary information to the GPS receiver comprises the step of transmitting the auxiliary information on a Stand alone Dedicated Control CHannel in a Global System for Mobile communication cellular telephone network.

9. The method recited in claim 1, wherein the step of transmitting the auxiliary information to the GPS receiver comprises the step of transmitting the auxiliary information on a Digital Control CHannel in a Digital Advanced Mobile Phone Service cellular telephone network.

10. The method recited in claim 1, wherein the step of transmitting the auxiliary information to the GPS receiver comprises the step of transmitting the auxiliary information on a Short Message Service message.

11. The method recited in claim 1, wherein the auxiliary information includes a satellite elevation angle for each of the GPS satellites included in the auxiliary information.

12. The method recited in claim 1, wherein the GPS satellites included in the auxiliary information are listed according to their respective elevation angles in descending order.

13. An apparatus comprising:

a series of delay lines for producing Gold codes of different delays;

a plurality of correlators for calculating correlation values from the Gold codes of different delays and a received GPS signal;

a vector generator for vectorizing the correlation values;

a plurality of accumulators for performing coherent combining of the serialized correlation values and producing accumulator values, each one of the plurality of accumulators being designed to be optimized to a GPS receiver moving at different speeds; and

a quadratic interpolator for performing a quadratic interpolation on an output of the accumulator having a strongest accumulator value and the output of two neighboring correlators.

14. A method comprising:

producing Gold codes of various delays;

calculating correlation values from the Gold codes and a received GPS signal;

serializing the calculated correlation values;

performing coherent combining of the serialized correlation values;

producing accumulator values; and

performing a quadratic interpolation of select accumulator values.

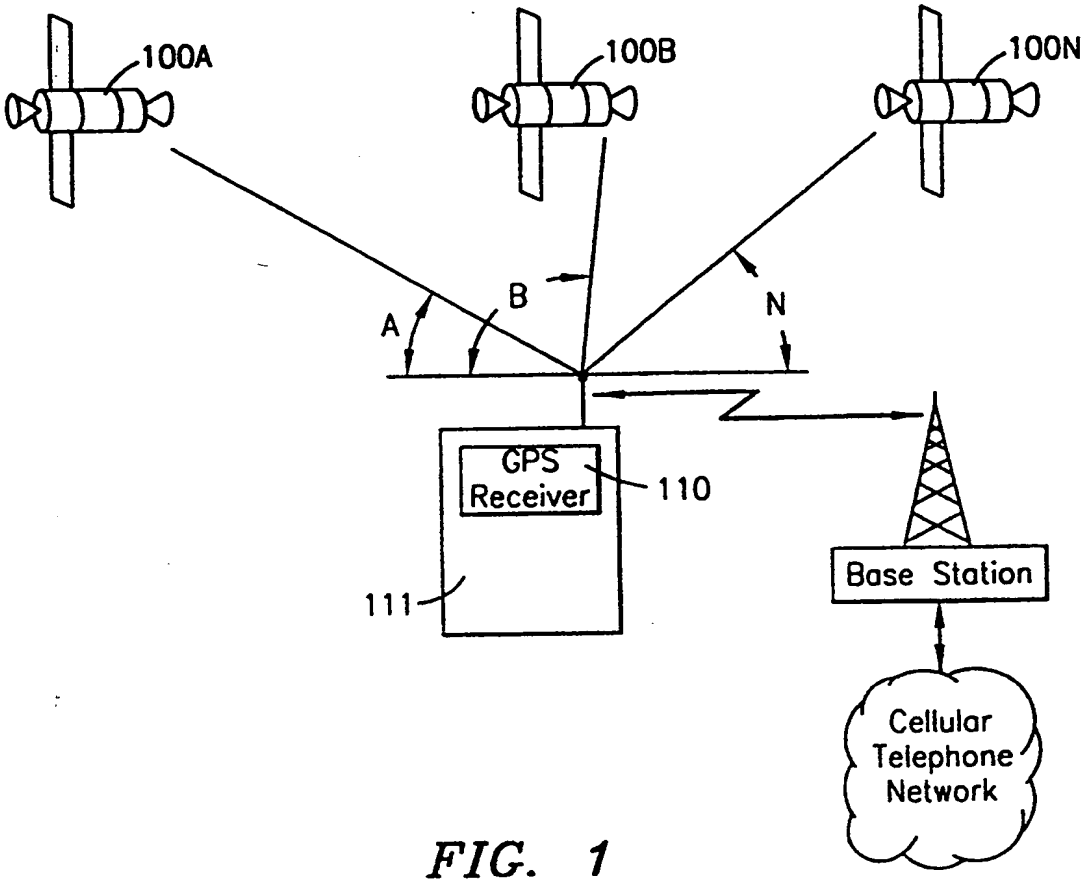

FIG. 1

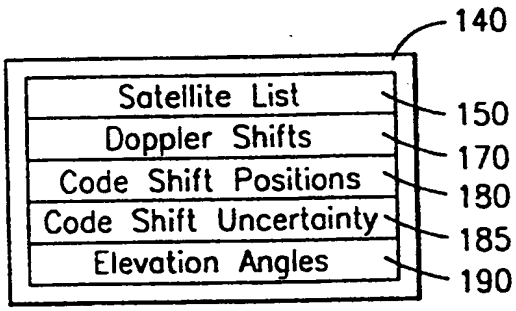

FIG. 2

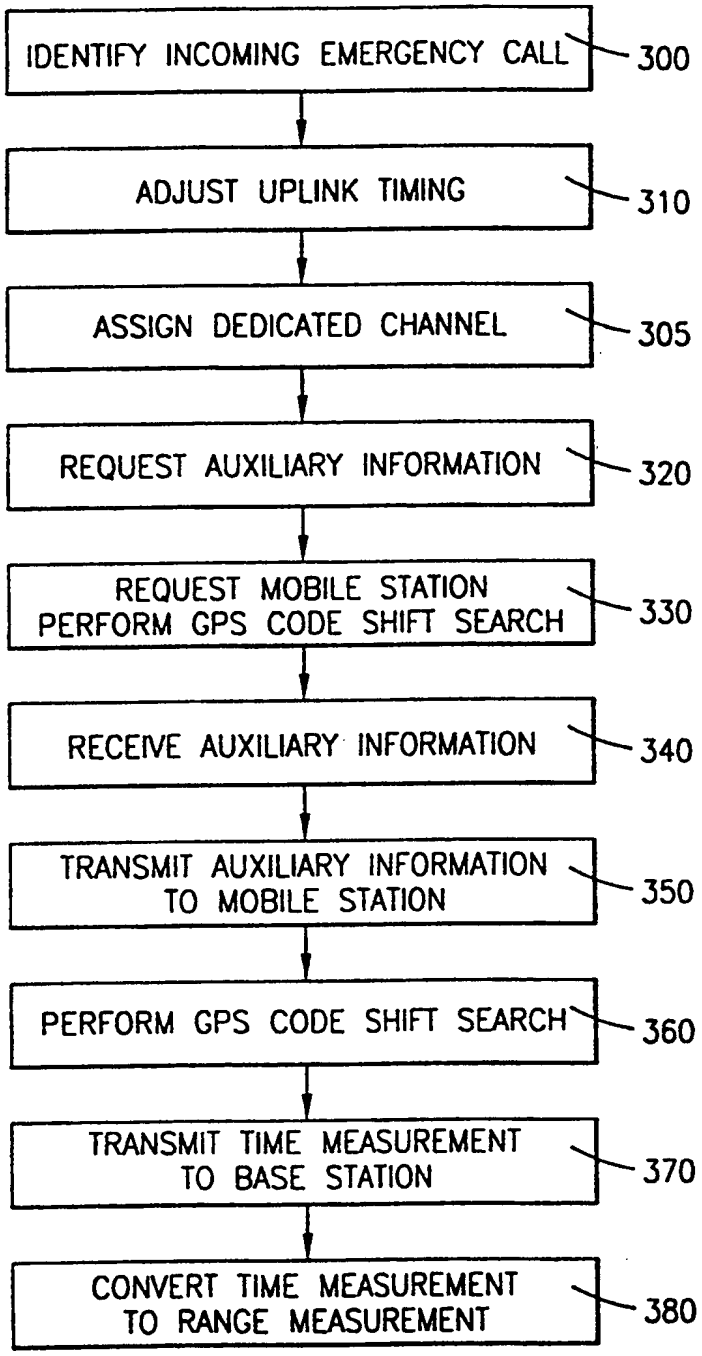
IDENTIFY INCOMING EMERGENCY CALL
300
ADJUST UPLINK TIMING
310
ASSIGN DEDICATED CHANNEL
305
REQUEST AUXILIARY INFORMATION
320
REQUEST MOBILE STATION PERFORM GPS CODE SHIFT SEARCH
330
RECEIVE AUXILIARY INFORMATION
340
TRANSMIT AUXILIARY INFORMATION TO MOBILE STATION
350
PERFORM GPS CODE SHIFT SEARCH
360
TRANSMIT TIME MEASUREMENT TO BASE STATION
370
CONVERT TIME MEASUREMENT TO RANGE MEASUREMENT
380

FIG. 3

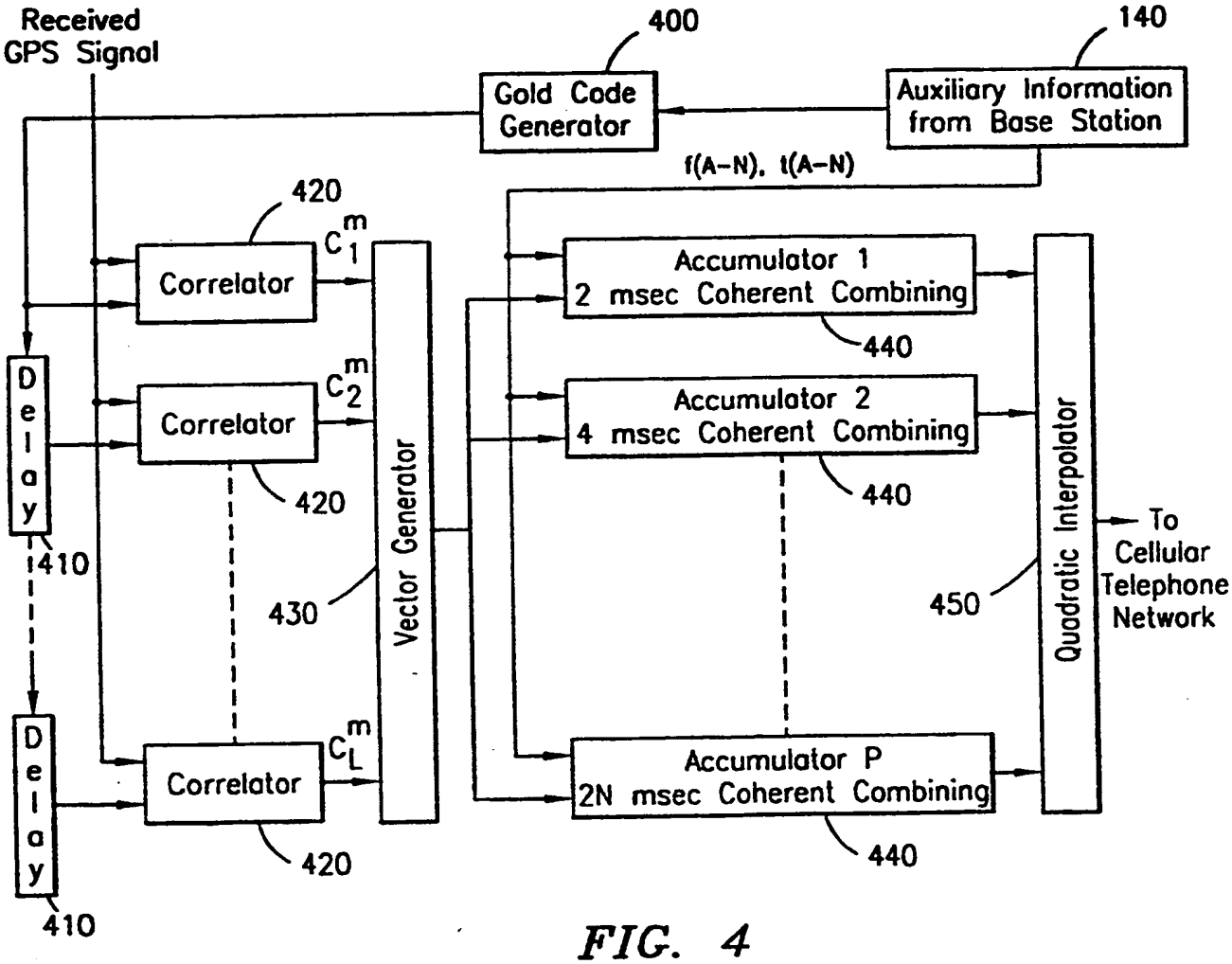

FIG. 4

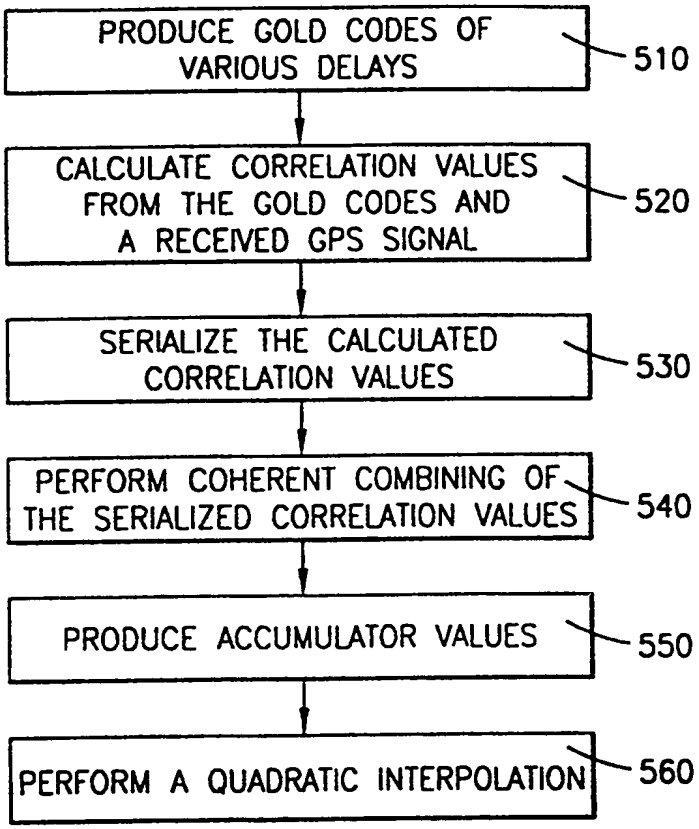

FIG. 5

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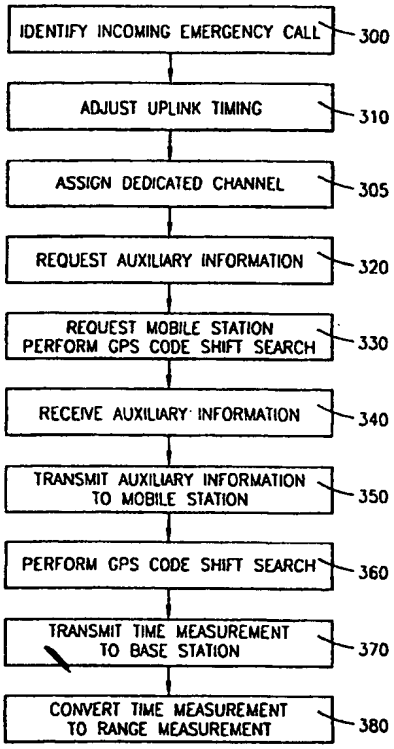
(57) Abstract

A method and apparatus for communicating auxiliary information between a cellular telephone network and a GPS receiver positioned within a mobile station and identifying the location of the mobile station. A dedicated channel between the mobile station and the network is assigned by the network and uplink timing between the mobile station and the network is adjusted. The network requests auxiliary information and also requests the GPS receiver to perform a GPS code shift search at a common reference time. Upon receiving the auxiliary information, the network transmits the auxiliary information to the GPS receiver which then performs the GPS code shift search. The GPS receiver incorporates a bank of correlators and accumulators to perform multiple parallel searches for various Doppler frequency shifts resulting from a moving GPS receiver. The mobile station subsequently transmits the location information to the cellular telephone network.



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CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
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CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

INTERNATIONAL SEARCH REPORT

Ir ational Application No
PCT/US 99/23382

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01S1/04 G01S5/00 G01S5/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01S H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 33382 A (SNAPTRACK INC ;KRASNER NORMAN F (US)) 12 September 1997 (1997-09-12)	1-3
Y	abstract; figure 1A page 2, line 6 - line 8 page 10, line 8 - line 14 page 11, line 25 -page 12, line 8 page 17, line 16 - line 24	4-6,8-10
Y	MOULY M: "The GSM System for Mobile Communications" 1993 , LASSAY-LES-CHATEAUX, EUROPE MEDIA , FRANCE XP002079145 * Section 6.3.1. "Initial Procedures: Access and Initial Assignment", page 367 - 372 *	4-6

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 May 2000	02. 06. 2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Niemeijer, R

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	MOULY M: "The GSM System for Mobile Communications" 1993 , LASSAY-LES-CHATEAUX, EUROPE MEDIA , FRANCE XP002131604 * Section 4.1.2.2. "Signaling outside a Call", page 191 *	8
Y	WO 98 37710 A (ERICSSON TELEFON AB L M) 27 August 1998 (1998-08-27) page 1, line 11 - line 27	9
Y	MOULY M: "The GSM System for Mobile Communications" 1993 , LASSAY-LES-CHATEAUX, EUROPE MEDIA , FRANCE XP002138447 * Section 1.3.1.3. "Short Message Services", pages 56 - 57 *	10
A	EP 0 774 843 A (GLOBALSTAR LP) 21 May 1997 (1997-05-21) column 3, line 44 - line 52 column 5, line 35 - line 36 column 7, line 55 -column 8, line 2	1,11
A	MOULY M: "The GSM System for Mobile Communications" 1993 , LASSAY-LES-CHATEAUX, EUROPE MEDIA , FRANCE XP002035632 * Section 6.1.5.2. "Timing Advance", page 346 - 349 *	1
A	US 5 809 424 A (EIZENHOEFER ALFONS) 15 September 1998 (1998-09-15) column 6, line 34 -column 7, line 20 column 10, line 10 - line 30	1
A	WO 98 02974 A (HARRISON DANIEL DAVID ;GEN ELECTRIC (US); TIEMANN JEROME JOHNSON ()) 22 January 1998 (1998-01-22) abstract; figures 5,14 page 20, line 15 - line 19 page 22, line 26 -page 23, line 8 page 31, line 25 -page 32, line 7	13,14

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 99/23382

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. [X] As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

[X] No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-3,7,11,12

   Fast acquisition of GPS signals

2. Claims: 4-6,8-10

   Transmission of information using specific channels in a cellular telephone network

3. Claims: 13,14

   Structure of GPS receiver

INTERNATIONAL SEARCH REPORT

Information on patent family members

In ɪtional Application No
PCT/US 99/23382

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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INTERNATIONAL SEARCH REPORT

Information on patent family members

In ational Application No
PCT/US 99/23382

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